LUND UNIVERSITY
School of Economics and Management

Testing for unit roots in the presence of structural change IRAN – GREECE CPI case

MASTER THESIS

Lund University
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May 2008

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Abstract

In this thesis we consider different tests for unit roots in the presence of structural change. We present the theory that lies behind unit roots, what we mean by structural change and try to detect the instances that "breaks" occur in the data. When performing a unit root test, when there is a structural change the results are biased toward accepting a unit root. Therefore, special care must be taken if it is suspected that such breaks have happened. Moreover, we will try to check these circumstances in real life data and perform various tests over these data. Our data is about the CPI (consumer product index) of Greece and Iran during 1948-2003. We try to see whether social or political events in contemporary history of these two once empires of world, have had any effect on their economy. Knowing this history we try to see if there appears to be a "break" in our data at certain years.

Key words:

Structural breaks, Unit root, Dickey-Fuller tests, Chow's breakpoint test.

1. Introduction

During the Iran-Iraq war years (1980-88) especially in the last years country faced various problems like sanctions, expenses of war, recession in economy, decrease in domestic products and imports resulting a huge deficit, increase in money supply and inflation.

Iran's economy is mainly oil-dependent therefore is highly affected by oil price. In respect that whenever oil price have stagnate or decreased, government revenue has increased which has resulted in an increase in government national debt which in turn has resulted in inflation.

In post war years, especially during president Rafsanjani era (89-97), many factors as well as government economic policies resulted in domestic and foreign debt and moreover oil price plunged drastically and as a result inflation increased significantly.

In the same period in Greece, a European country, we had the same problem as in Iran. As we know Greece has an impressive history but we begin with year 1940 and date 28th October which was the time that Greek dictator Ioannis Metaxas, famously responded to the Italian ultimatum with the single word "NO". In the following Greek-Italian war, Greece repelled Italian forces into Albania, giving the allies their first victory over Axis forces on land. The country would eventually fall to urgently dispatched German forces during the Battle of Greece, but the occupiers nevertheless met serious challenges from the Greek Resistance.

After liberation, Greece experienced a bitter civil war between Royalist and Communist forces, which led to economic devastation and severe social tensions between its Rightists and largely Communist Leftists for the next 30 years.

In 1965, a period of political turbulence led to a coup d'etat on April 21, 1967 by the US-backed Regime of the Colonels. On November 1973 the Athens Polytechni Uprising sent shock waves across the regime, and a counter-coup established Brigadier Dimitrios Ioannides as dictator. On July 20, 1974, as Turkey invaded the island of Cyprus, the regime collapsed. July 24, 1974: Democracy is restored again and the politicians return from exile.

Greece became the tenth member of the European Union on January 1, 1981 and ever since, the nation has experienced a remarkable and sustained economic growth. Widespread investments in industrial enterprises and heavy infrastructure, as well as funds from the European Union and growing revenues from tourism, shipping and a fast growing service sector have raised the country's standard of living to unprecedented levels. The country adopted the Euro in 2001, and successfully organised the 2004 Olympic Games in Athens.

All the previous make us to be interested in studying the political effects on the economical series and namely on the CPI. The purpose of this thesis is to study the CPI in the context of univariate Time series analysis. In the next section we introduce the statistical theory, while in section 3 the data analysis and finally in section 4 the conclusions and summary.

2. Theory

Covariance Stationarity

A time series is considered to be covariance stationary, hereafter just stationary, if its mean and variance are independent of time. In order for a time series to be covariance stationary, it must fulfil the conditions below:

1. $E(y_t) = \mu$ $t = 1, 2, ..., \infty$ Unconditional mean
2. $Var(y_t) = \sigma^2$ $< \infty$ Unconditional variance
3. $Cov(y_t, y_{t-s}) = \gamma_s$ Auto-covariance

A non-stationary time series can be converted into a stationary time series by differencing. Sometimes we have to differenciate more than one time to achieve stationarity.

Unit root tests

Tests such as Dickey – Fuller (DF) and Augmented Dickey – Fuller (ADF) have been widely used to check the stationarity and presence of unit root of a process. The Dickey – Fuller test is valid only for AR(1), if there is higher order correlation, then we need to use ADF. Also another difference between these two tests is that we use the DF test when the residual are not autocorrelated, while the ADF is used when there is autocorrelation between the residuals. Dickey – Fuller considered the estimation of the parameter α from the models.

1. $y_t = \alpha y_{t-1} + e_t$ (pure random walk)
2. $y_t = \mu + \alpha y_{t-1} + e_t$ (drift + random walk)
3. $y_t = \mu + bt + \alpha y_{t-1} + e_t$ (drift + linear trend)

It assumes that y_0=0 and $e_t \sim i.i.d(0, \sigma^2)$

The null and alternative hypotheses are:

H_0: $\alpha=1$ ($\alpha(z)=0$ has a unit root)
H_1: $|\alpha|<1$ ($\alpha(z)=0$ has root outside unit circle)

Alternative representation of Dickey-Fuller (DF) test

$$y_t = \alpha y_{t-1} + e_t \Rightarrow y_t - y_{t-1} = \alpha y_{t-1} - y_{t-1} + e_t$$

1. $\Delta y_t = (\alpha - 1) y_{t-1} + e_t \equiv \gamma y_{t-1} + e_t$ (τ)

In the same way we have

2. $\Delta y_t = \mu + \gamma y_{t-1} + e_t$ (τ_μ)
3. $\Delta y_t = \mu + bt + \gamma y_{t-1} + e_t$ (τ_τ)

Three cases to consider:

Test	Model	Hypothesis
$\hat{\tau}$	$\Delta y_t = \gamma y_{t-1} + \varepsilon_t$	H_0: $\gamma=0$
$\hat{\tau}_\mu$	$\Delta y_t = \mu + \gamma y_{t-1} + \varepsilon_t$	H_0: $\mu=0$; $\gamma=0$
$\hat{\tau}_\tau$	$\Delta y_t = \mu + \gamma y_{t-1} + \beta t + \varepsilon_t$	H_0: $\beta=0$; $\gamma=0$

Critical values depend on specification of null and alternative hypothesis. One – sided test usually used to maximize power:
H_0: $\gamma=0$ against H_1: $\gamma<0$; as $\gamma>0 \Rightarrow$ explosive process

A Single structural break known a priori

Structural breaks create difficulties in determining whether a stochastic process is stationary or not. If we unsuspectingly perform Dickey-Fuller tests in presence of structural breaks the result are biased towards the nonrejection of a unit root. When we test for a structural change in our data we usually do not know when the breakpoint actually occurs. If we know the breakpoint, one econometric procedure is to test for unit roots in the presence of a structural break which involves splitting the sample into two parts and using the Dickey – Fuller tests on each part.

Figure .1 (example of structural break)

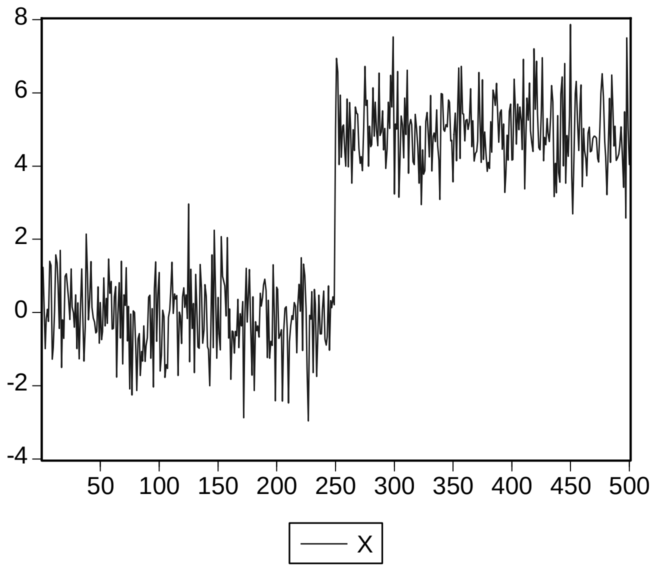


Figure .1 shows an obvious structural change in our data. (Random generated series normally distributed).

Another approach to this problem was introduced in 1989 by Perron. Perron showed that in the presence of a structural break in time series, many perceived non-stationary series were in fact stationary. Perron proved that time series were stationary when exogenous structural break was included. Perron allows for a time structural change occurring at a time T_B ($1< T_B <T$), where T is the number of observations.

The models that were introduced by Perron are the following:

Null Hypothesis:

Model (A): $y_t = \mu + dD(TB)_t + y_{t-1} + e_t$

Model (B): $y_t = \mu_1 + y_{t-1} + (\mu_2 - \mu_1)DU_t + e_t$

Model (C): $y_t = \mu_1 + y_{t-1} + dD(TB)_t + (\mu_2 - \mu_1)DU_t + e_t$

where $D(TB)_t=1$ if $t=T_B+1$, 0 otherwise, and $DU_t=1$ if $t>T_B$, 0 otherwise.

Alternative Hypothesis:

Model (A): $y_t = \mu_1 + \beta t + (\mu_2 - \mu_1)DU_t + e_t$

Model (B): $y_t = \mu + \beta_1 t + (\beta_2 - \beta_1)DT_t + e_t$

Model (C): $y_t = \mu_1 + \beta_1 t + (\mu_2 - \mu_1)DU_t + (\beta_2 - \beta_1)DT_t + e_t$

where $DT_t=t-T_B$, if $t>T_B$, and 0 otherwise

Model A permits an exogenous change in the level of the series. Model B permits an exogenous change in the rate of growth. Model C allows change in both. These models include one known structural break and can not be applied in data that breaks are unknown. So, depending on the data we have, we analyse it accordingly.

Comment: The notation of the above models is the same with the original papers (*P. Perron, 1989*)

Breakpoint Tests

In order to look for break points in our data we use Chow's breakpoint test. Chow test is to fit the equation separately for each subsample and to see whether there are significant differences in the estimated equations. A significant difference indicates a structural change in the relationship. We first divide our sample in two subsamples. Each subsample must contain more observations than the number of coefficients in the equation so that the equation can be estimated. The Chow breakpoint test compares the sum of squared residuals obtained by fitting a single equation to the entire sample with the sum of squared residuals obtained when separate equations are fit to each subsample of the data. The *F*-statistic is based on the comparison of the restricted and unrestricted sum of squared residuals and in the simplest case involving a single breakpoint, is computed as:

$$F = \frac{(\bar{u}'\bar{u} - (u_1'u_1 + u_2'u_2))/k}{(u_1'u_1 + u_2'u_2)/(T-2k)}$$

where $\bar{u}'\bar{u}$ is the restricted sum of squared residuals, $u_i'u_i$ is the sum of squared residuals from subsample *i*, *T* is the total number of observations, and *k* is the number of parameters in the equation. This formula can be generalized naturally to more than one breakpoint. The *F*-statistic has an exact finite sample *F*-distribution if the errors are independent and identically distributed normal random variables. The log likelihood ratio statistic is based on the comparison of the restricted and unrestricted maximum of the (Gaussian) log likelihood function. The LR test statistic has an asymptotic χ^2 distribution with degrees of freedom equal to $(m-1)k$ under the null hypothesis of no structural change, where m is the number of subsamples.

3. Data

The data is about the CPI (Consumer Product Index) of Greece and Iran. The structure of the data is annual, which means that we observe the price of CPI each year. The range of observations is 56 years beginning at 1948 and ending at 2003. (Data is obtained from internet www.econstats.com). We will analyze the data for probable presence of structural break, due to a political or social cause. This means, knowing each country's history we can give reason why there is a structural break at that certain time and we know a priori when the break will happen. In order to analyze our data we will use E-Views® version 6.

Iran

We begin our research with Iran’s economy. First of all we produce the graph of our data to get a representation of how the data looks like. This will help us draw some conclusions, which we will be able to fully defend them, using in depth analysis of our data. The CPI has an exponential graph at around 1990 (figure 2). In order to work with the CPI we produce another time series LCPI, which is the logarithm of original CPI (figure 3). In order to make our time series linear and easier to analyze we take its’ logarithm. The first impression is that the series are not stationary.

Figure .2 (CPI graph)

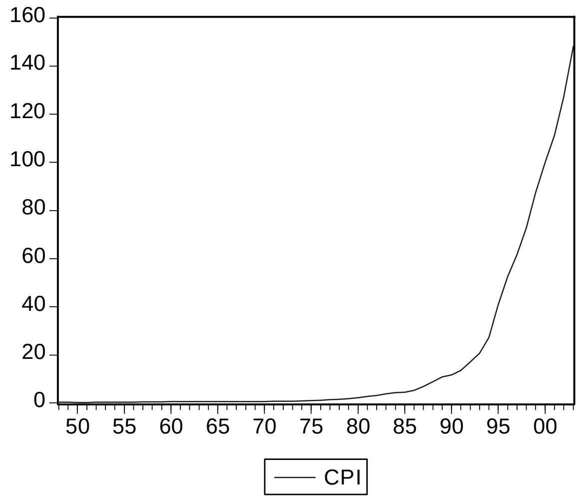
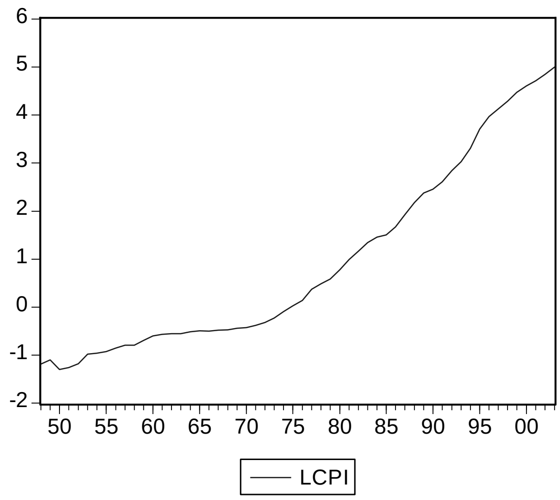


Figure .3 (LCPI graph)



In order to verify our conclusions we perform a unit root test. Table .1 indicates clearly the presence of a unit root in our data.

Table .1 (ADF Test on LCPI)

Null Hypothesis: LCPI has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		2.484477	1.0000
Test critical values:	1% level	-3.557472	
	5% level	-2.916566	
	10% level	-2.596116	

*MacKinnon (1996) one-sided p-values.

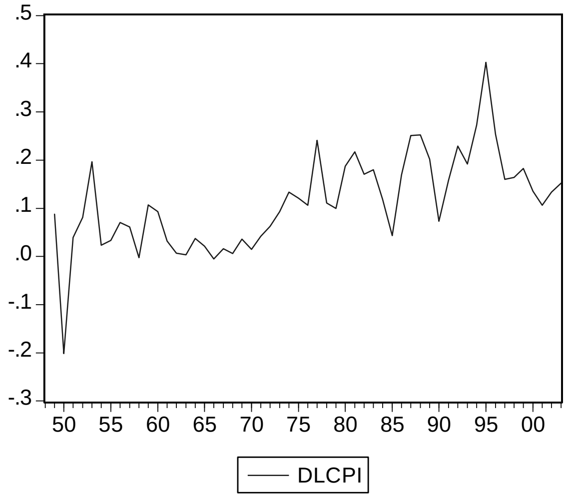
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LCPI)
Method: Least Squares
Date: 05/03/08 Time: 17:05
Sample (adjusted): 1950 2003
Included observations: 54 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LCPI(-1)	0.017221	0.006931	2.484477	0.0163
D(LCPI(-1))	0.409115	0.134190	3.048775	0.0036
C	0.051707	0.015707	3.292003	0.0018

R-squared	0.450190	Mean dependent var	0.112871
Adjusted R-squared	0.428629	S.D. dependent var	0.097918
S.E. of regression	0.074016	Akaike info criterion	-2.315127
Sum squared resid	0.279394	Schwarz criterion	-2.204628
Log likelihood	65.50844	F-statistic	20.87967
Durbin-Watson stat	1.622628	Prob(F-statistic)	0.000000

Since our time series is not stationary, we have to produce the first difference DLCPI, in order to continue our analysis. Figure .4 is the illustration of the first difference of our time series.

Figure .4 (DLCPI graph)



The first difference of our time series seems stationary. We perform also a unit root test in our time series.

Table .2
Augmented Dickey – Fuller

Null Hypothesis: DLCPI has a unit root
Exogenous: None
Lag Length: 2 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.953549	0.2994
Test critical values:	1% level	-2.610192	
	5% level	-1.947248	
	10% level	-1.612797	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DLCPI)
Method: Least Squares
Date: 05/07/08 Time: 13:07
Sample (adjusted): 1952 2003
Included observations: 52 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
DLCPI(-1)	-0.062955	0.066021	-0.953549	0.3450
D(DLCPI(-1))	-0.124054	0.131428	-0.943896	0.3499
D(DLCPI(-2))	-0.229359	0.114372	-2.005371	0.0505

R-squared	0.117987	Mean dependent var	0.002172
Adjusted R-squared	0.081987	S.D. dependent var	0.069234
S.E. of regression	0.066335	Akaike info criterion	-2.532233
Sum squared resid	0.215617	Schwarz criterion	-2.419661
Log likelihood	68.83806	Hannan-Quinn criter.	-2.489076
Durbin-Watson stat	2.185718		

Table .3
Phillips – Perron

Null Hypothesis: DLCPI has a unit root
Exogenous: None
Bandwidth: 9 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.990766	0.0454
Test critical values:	1% level	-2.608490	
	5% level	-1.946996	
	10% level	-1.612934	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.006618
HAC corrected variance (Bartlett kernel)	0.006038

Phillips-Perron Test Equation
Dependent Variable: D(DLCPI)
Method: Least Squares
Date: 05/07/08 Time: 13:13
Sample (adjusted): 1950 2003
Included observations: 54 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
DLCPI(-1)	-0.157108	0.075577	-2.078796	0.0425

R-squared	0.075202	Mean dependent var	0.001202
Adjusted R-squared	0.075202	S.D. dependent var	0.085390
S.E. of regression	0.082116	Akaike info criterion	-2.143022
Sum squared resid	0.357381	Schwarz criterion	-2.106189
Log likelihood	58.86160	Hannan-Quinn criter.	-2.128817
Durbin-Watson stat	2.060181		

The above tables are the results of ADF – test (Table .2) and Phillips – Perron Test (Table .3). According to the results ADF that we get that there is a unit root in the ADF test, while Phillips – Perron results depict the opposite. This means that we get a unit root with the ADF test while there is stationarity using Phillips – Perron. In order to conclude whether our time series is stationary or not, we have to produce also the correlogram (figure5). The correlogram below, shows stationarity. However, we know that the Phillips – Perron test can detect any structural breaks and is considered more reliable than the ADF test in our case.

Figure .5 (Correlogram of DLCPI)

Date: 05/04/08 Time: 10:40
Sample: 1948 2003
Included observations: 55

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.618	0.618	22.171	0.000
		2	0.409	0.043	32.051	0.000
		3	0.376	0.175	40.588	0.000
		4	0.445	0.238	52.782	0.000
		5	0.389	0.006	62.284	0.000
		6	0.416	0.200	73.373	0.000
		7	0.409	0.063	84.313	0.000
		8	0.363	-0.001	93.083	0.000
		9	0.190	-0.204	95.555	0.000
		10	0.136	-0.081	96.835	0.000
		11	0.200	0.063	99.683	0.000
		12	0.221	-0.022	103.25	0.000
		13	0.160	-0.015	105.17	0.000
		14	0.153	0.048	106.96	0.000
		15	0.133	-0.003	108.36	0.000
		16	0.073	-0.027	108.79	0.000
		17	0.048	0.025	108.98	0.000
		18	0.065	-0.020	109.34	0.000
		19	-0.034	-0.240	109.44	0.000
		20	-0.043	0.027	109.60	0.000
		21	-0.053	-0.045	109.86	0.000
		22	-0.104	-0.140	110.88	0.000
		23	-0.188	-0.095	114.35	0.000
		24	-0.209	-0.059	118.79	0.000

The correlogram shows that the model is an AR(1), looking at the spike of the ACF, but after some checks on different models we can see that the most suitable one is an ARIMA(|2|,1,1).

Table .4 (Model)

Dependent Variable: DLCPI
Method: Least Squares
Date: 05/04/08 Time: 10:44
Sample (adjusted): 1951 2003
Included observations: 53 after adjustments
Convergence achieved after 208 iterations
Backcast: 1950

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.125866	0.026664	4.720417	0.0000
AR(2)	0.422679	0.102273	4.132836	0.0001
MA(1)	0.821697	0.087676	9.371970	0.0000

R-squared	0.539293	Mean dependent var	0.118806
Adjusted R-squared	0.520865	S.D. dependent var	0.088509
S.E. of regression	0.061266	Akaike info criterion	-2.692251
Sum squared resid	0.187675	Schwarz criterion	-2.580725
Log likelihood	74.34465	F-statistic	29.26442
Durbin-Watson stat	1.971045	Prob(F-statistic)	0.000000

Inverted AR Roots	.65	-.65
Inverted MA Roots	-.82	

Looking back at the DLCPI graph of Iran we cannot clearly see the structural breaks but we can check as below if such breaks exist or not.

Table .5 (Chow Breakpoint Test Results on 1988, 1997)

Chow Breakpoint Test: 1997

F-statistic	0.262606	Prob. F(3,47)	0.851973
Log likelihood ratio	0.881029	Prob. Chi-Square(3)	0.830003

Chow Breakpoint Test: 1988

F-statistic	1.625498	Prob. F(3,47)	0.196099
Log likelihood ratio	5.232068	Prob. Chi-Square(3)	0.155572

The reason why we get these breakpoints at these years are:

During the Iran-Iraq war years (1980-88) especially in the last years, sanctions, expenses of war, recession in economy, decrease in domestic products and imports caused a huge deficit, increase in money supply and inflation. As soon as Iran accepted the 598 UN ceasefire, suddenly prices decreased because of psychological reasons. But then after that increased to the previous levels.

In post war years, during president Rafsanjani era, government dismantled rationing. Then importing a slew of industries was begun. Government domestic and foreign debt sky rocketed which result in inflation. Government increased the deficit and money supply especially in the last years (94-97), when government couldn't pay back the external debt and oil price also plunged to 10-20$ so inflation increased to 50-60%.

Greece

We now begin analyzing Greece's data. First of all we produce the graph of our data to get an illustration of the data. This will help us draw some conclusions, which we will be able to fully defend them, using in depth analysis of our data. The figures below are a representation of the CPI. We see that the CPI (figure 6) is slowly increasing the first years. From year 1975 we, see that this line becomes exponential and increases really fast, without decreasing at any year.

At first look we can conclude that our series is by no mean stationary, which means that there is definitely a unit root in our process.

In order to examine our time series we have to make the graph more linear. Since we see that it appears to be exponential we can use the logarithm to make it linear. So, we get the LCPI (figure 7) which appears to be linear and gives us a better projection of our time series. We can still see how the CPI changes as the years go by and we gather the same results as before.

Figure .6 (CPI graph)

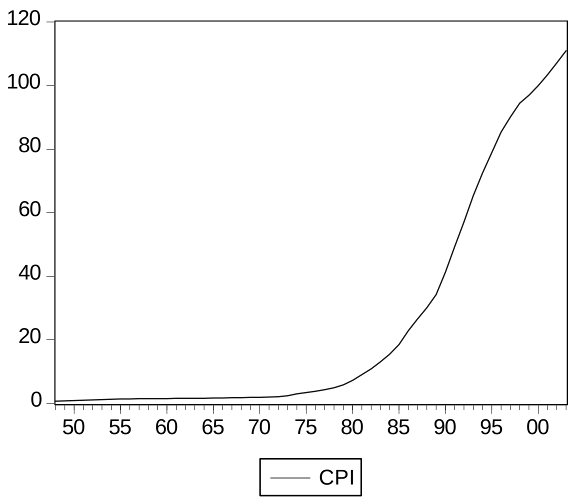
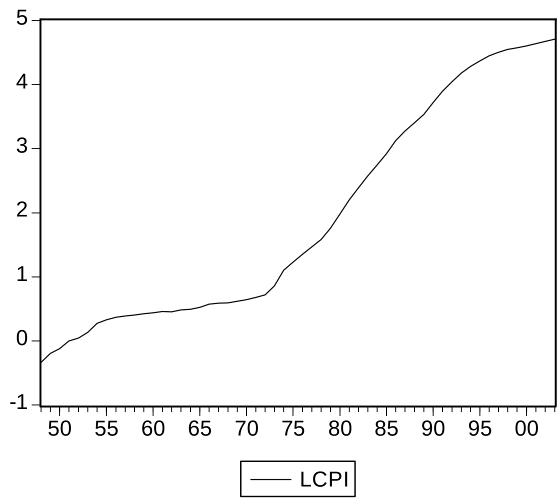


Figure .7 (LCPI graph)



The conclusions that we drew by looking at the figures are also verified by performing a unit root test. Table .6 shows us clearly that our time series is non-stationary and in order to proceed with our analysis, we have to use the first difference to make our time series stationary.

Table .6 (ADF Test on LCPI)

Null Hypothesis: LCPI has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.140257	0.9393
Test critical values:	1% level	-3.557472	
	5% level	-2.916566	
	10% level	-2.596116	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LCPI)
Method: Least Squares
Date: 04/26/08 Time: 10:59
Sample (adjusted): 1950 2003
Included observations: 54 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LCPI(-1)	-0.000447	0.003190	-0.140257	0.8890
D(LCPI(-1))	0.850868	0.077747	10.94404	0.0000
C	0.012795	0.009565	1.337650	0.1869

R-squared	0.715542	Mean dependent var	0.090828
Adjusted R-squared	0.704386	S.D. dependent var	0.068902
S.E. of regression	0.037462	Akaike info criterion	-3.677022
Sum squared resid	0.071574	Schwarz criterion	-3.566523
Log likelihood	102.2796	F-statistic	64.14403
Durbin-Watson stat	1.954224	Prob(F-statistic)	0.000000

We continue analysing our data. In order to do so, we have to use the first difference to make our time series stationary. We produce the DLCPI (figure 8), which is the first difference of the LCPI. Looking at the series, it appears to be stationary. In fact, it is stationary, even though the unit root tests show non-stationarity. This happens since there is a structural break in our data. We can clearly see the structural break in our data in year 1975, also there is another one in year 1981.

Figure .8 (DLCPI graph)

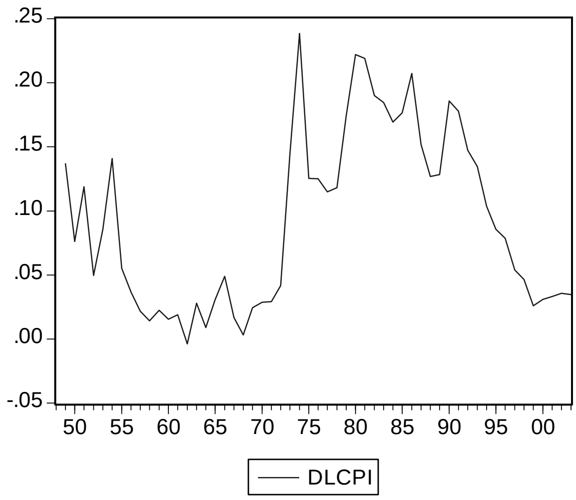


Table .7
Augmented Dickey – Fuller Test on DLCPI

Null Hypothesis: DLCPI has a unit root
Exogenous: None
Lag Length: 0 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.500436	0.1238
Test critical values:	1% level	-2.608490	
	5% level	-1.946996	
	10% level	-1.612934	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DLCPI)
Method: Least Squares
Date: 05/07/08 Time: 17:09
Sample (adjusted): 1950 2003
Included observations: 54 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLCPI(-1)	-0.066513	0.044329	-1.500436	0.1394

R-squared	0.038360	Mean dependent var	-0.001888
Adjusted R-squared	0.038360	S.D. dependent var	0.038213
S.E. of regression	0.037473	Akaike info criterion	-3.712064
Sum squared resid	0.074423	Schwarz criterion	-3.675231
Log likelihood	101.2257	Durbin-Watson stat	2.046719

Table .8
Phillips – Perron Test on DLCPI

Null Hypothesis: DLCPI has a unit root
Exogenous: None
Bandwidth: 4 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.374221	0.1554
Test critical values:	1% level	-2.608490	
	5% level	-1.946996	
	10% level	-1.612934	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.001378
HAC corrected variance (Bartlett kernel)	0.000984

Phillips-Perron Test Equation
Dependent Variable: D(DLCPI)
Method: Least Squares
Date: 05/07/08 Time: 17:12
Sample (adjusted): 1950 2003
Included observations: 54 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLCPI(-1)	-0.066513	0.044329	-1.500436	0.1394

R-squared	0.038360	Mean dependent var	-0.001888
Adjusted R-squared	0.038360	S.D. dependent var	0.038213
S.E. of regression	0.037473	Akaike info criterion	-3.712064
Sum squared resid	0.074423	Schwarz criterion	-3.675231
Log likelihood	101.2257	Durbin-Watson stat	2.046719

The ADF test shows that there is a unit root in our time series (Table .7), the same happens with the Phillips – Perron test (Table 8). We also produce the correlogram (figure .9). The correlogram shows stationarity.

Moving on, we test these observations, to check if there is indeed a structural break in our data. But before we do so, we have to find the model that best describes our data. We look at the correlogram of the data.

So, the question is: Is our data stationary or is it not after all? We can not tell by the tests, since we can see that even Phillips – Perron test is biased towards non stationarity, since the graph clearly indicates when the breakpoint occurs. We can divide our data in two subsamples and check with the use of the correlogram if there is stationarity.

Figure .9 (Correlogram of DLCPI 1948 -1972)

Date: 05/12/08 Time: 14:09
Sample: 1948 2003
Included observations: 24

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.516	0.516	7.2212	0.007
		2	0.472	0.280	13.539	0.001
		3	0.358	0.057	17.350	0.001
		4	0.265	-0.020	19.546	0.001
		5	0.284	0.111	22.191	0.000
		6	0.015	-0.296	22.198	0.001
		7	-0.088	-0.214	22.485	0.002
		8	-0.189	-0.122	23.884	0.002
		9	-0.172	0.061	25.111	0.003
		10	-0.166	0.035	26.346	0.003
		11	-0.198	0.056	28.228	0.003
		12	-0.109	0.166	28.850	0.004

Figure .10 (Correlogram of DLCPI 1975-2000)

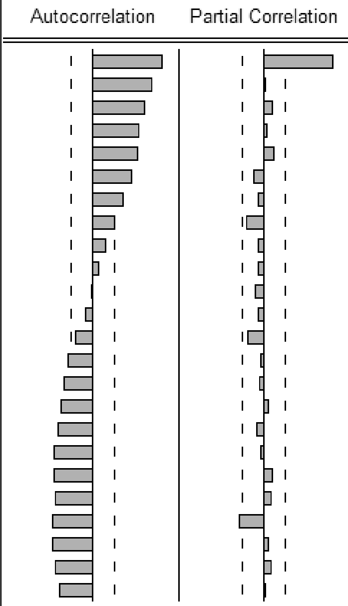
Date: 05/12/08 Time: 14:10
Sample: 1948 2003
Included observations: 26

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.816	0.816	19.407	0.000
		2	0.569	-0.292	29.230	0.000
		3	0.398	0.119	34.247	0.000
		4	0.288	-0.019	36.984	0.000
		5	0.203	-0.019	38.411	0.000
		6	0.083	-0.182	38.662	0.000
		7	-0.045	-0.062	38.740	0.000
		8	-0.134	-0.029	39.468	0.000
		9	-0.135	0.130	40.245	0.000
		10	-0.066	0.099	40.444	0.000
		11	-0.065	-0.204	40.650	0.000
		12	-0.188	-0.300	42.486	0.000

According to the above figures we can see that our timeserie is stationary in each subperiod. So we can see that these tests are not reliable when there is a one - time change in the mean of an otherwise stationary sequence.

Figure .11 (Correlogram of DLCPI)

Date: 05/02/08 Time: 10:11
Sample: 1948 2003
Included observations: 55



	AC	PAC	Q-Stat	Prob
1	0.837	0.837	40.642	0.000
2	0.707	0.024	70.221	0.000
3	0.627	0.100	93.953	0.000
4	0.562	0.029	113.38	0.000
5	0.533	0.115	131.22	0.000
6	0.461	-0.123	144.83	0.000
7	0.374	-0.075	153.98	0.000
8	0.256	-0.199	158.35	0.000
9	0.155	-0.065	159.98	0.000
10	0.077	-0.074	160.39	0.000
11	-0.012	-0.111	160.40	0.000
12	-0.092	-0.075	161.02	0.000
13	-0.206	-0.184	164.17	0.000
14	-0.293	-0.039	170.72	0.000
15	-0.355	-0.053	180.57	0.000
16	-0.385	0.047	192.50	0.000
17	-0.422	-0.084	207.20	0.000
18	-0.469	-0.032	225.85	0.000
19	-0.467	0.099	244.82	0.000
20	-0.443	0.097	262.43	0.000
21	-0.492	-0.288	284.78	0.000
22	-0.493	0.047	307.88	0.000
23	-0.450	0.084	327.69	0.000
24	-0.405	0.009	344.28	0.000

Also, the correlogram (figure .11) shows a big spike in the PACF, while the ACF appears not to be stationary. The model is an ARIMA(1,1,0) with a constant C.

Table .9 (Model)

Dependent Variable: DLCPI
Method: Least Squares
Date: 05/02/08 Time: 10:13
Sample (adjusted): 1950 2003
Included observations: 54 after adjustments
Convergence achieved after 3 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.080299	0.033753	2.379000	0.0211
AR(1)	0.847928	0.074159	11.43385	0.0000

R-squared	0.715432	Mean dependent var	0.090828
Adjusted R-squared	0.709959	S.D. dependent var	0.068902
S.E. of regression	0.037107	Akaike info criterion	-3.713673
Sum squared resid	0.071601	Schwarz criterion	-3.640007
Log likelihood	102.2692	F-statistic	130.7330
Durbin-Watson stat	1.948392	Prob(F-statistic)	0.000000

Inverted AR Roots .85

There is a clear indication that there exists a breakpoint in our data, using Chow's Breakpoint Test. If we perform this test using different dates, we will get different results and maybe, more than one breakpoints. These dates present the biggest statistics in our data and also, they were not chosen by accident.

Table .10 (Chow Breakpoint Test on 1975, 1982)

Chow Breakpoint Test: 1975

F-statistic	0.041159	Prob. F(2,50)	0.959709
Log likelihood ratio	0.088835	Prob. Chi-Square(2)	0.956555

Chow Breakpoint Test: 1982

F-statistic	0.232868	Prob. F(2,50)	0.793112
Log likelihood ratio	0.500671	Prob. Chi-Square(2)	0.778540

As we can see after the analysis of Greece's CPI, the historical events do reflect on the country's economy. During the year 1975 we have the restoration of the Greek democracy and the fall of dictatorship. People are free again after many years of wars and different political regimes. Also in 1982, Greece finally entered the European Union, after many years of preparation to fulfil the European Union's criteria. We can see that according to our data set the effect of each political change in Greece is reflected with one year lag, as the fall of the dictator occurred in 1974 and the entrance in the European Union was in 1981.

Conclusions

To summarize, we analyzed the CPI data for Iran and Greece. We perform different unit root tests in the presence of structural breaks. After presenting the theory of ADF and Chow Breakpoint, we perform a small analysis for both Iran and Greece and demonstrate the difficulties of dealing with breaks and a way to handle them.

After this research with real data, we can conclude that one cannot always be absolutely sure which method is the most appropriate. And there are various models of unit root test for the data; models with intercept, trend or both, that a researcher has to choose individually for each case.

Moreover, after analyzing our data we can clearly see that in majority of the times in small countries, economy is highly affected by politics. A change in the politics, a change in the currency can cause considerable non stability in economy.

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